

U.S. Patent Appln. No. 10/726,759
Amendment
Reply to Office Action dated March 22, 2005

Docket No. 9665-1

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Cancelled)

2. (Currently amended) The stage according to claim 1, A 3-axis straight line motion stage comprising:

a bottom plate having a predetermined area and thickness;

an X-axis stage fixed in a reference area of the bottom plate, for moving in the direction of the X-axis, a first X area positioned from the reference area to the direction of the X-axis;

a Y-axis stage, positioned within the first X area and fixed in a second X area, which is located within the first X area for moving in the direction of the Y-axis a second Y area positioned from the second X area to the direction of the Y-axis; and

a Z-axis stage fixed in the second Y area, which is located within the first Y area and supports a predetermined sample for moving the sample in the direction of the Z-axis;

wherein the X-axis stage (10) comprises comprising:

a piezoelectric element having a predetermined length, the length being changed in the direction of the Y-axis according to an input voltage[.];

and a first X driving part (11-1) and a second X driving part (11-2) connected to both ends of a longitudinal direction of the piezoelectric element (13), respectively, for moving in the X-axis direction the a second X end (16-2) within the first X area (11-1) from a first X end (16-1) within the reference area (RR) in the center of the piezoelectric element (13) according to driving of the piezoelectric element (13).

wherein the X-axis, the Y-axis and the Z-axis indicate axes of rectangular coordinates, respectively.

U.S. Patent Appln. No. 10/726,759

Docket No. 9665-1

Amendment

Reply to Office Action dated March 22, 2005

3. (Currently amended) The stage according to claim [[1]] 2, wherein the first and second X driving parts (11-1, 11-2) comprise[[s]] first and second X amplifying parts (12-1, 12-2) amplifying a displacement generated according to the driving of the piezoelectric element, (13) and moving third and forth fourth X ends (16-3, 16-4) formed in the opponent on a side opposite to side of the first X end (16-1) in the center of the piezoelectric element, in the direction of the X-axis by the amplified displacement,

first and second X-line motion parts (13-1, 13-2) shifted in parallel in the direction of the X-axis by the amplified displacement,

first and second slits (19-1B, 19-1C) connecting the third and fourth X ends (16-3, 16-4) to first ends of the first and second X-line motion parts (13-1, 13-2), respectively, and

a third slit (19-1A) connecting the other a second end opponent opposite to the first end of the first X-line motion part (13-1), which is connected to the third X end, (16-3) to the other a second end opponent opposite to the first end of the second X-line motion part (13-2), which is connected to the fourth X end (16-4).

4. (Currently amended) The stage according to claim 3, wherein the first and second X amplifying parts (12-1, 12-2) comprise[[s]] first and second pressing parts (14-1, 14-2) receiving the displacement of the piezoelectric element, [[an]] intermediate rods formed in the longitudinal direction of the piezoelectric element towards the both sides of the first and second pressing part (14-1, 14-2) in the center of the respective first and second pressing parts (14-1, 14-2), and fourth and fifth slits connecting the first and second pressing parts (14-1, 14-2) to the other ends opponent to the ends of the intermediate rods (15-1) each other, respectively.

5. (Currently amended) The stage according to claim 4, wherein the intermediate rod comprises a post part (15-A) formed to have a predetermined width, and a narrowing part (15-1B) having a thickness relatively thinner than the width of the post part by a semicircular groove (15-1C) having a predetermined radius in both ends of the post part (15-1A).

U.S. Patent Appln. No. 10/726,759

Docket No. 9665-1

Amendment

Reply to Office Action dated March 22, 2005

6. (Currently amended) The stage according to claim 5, wherein the respective first and second X amplifying parts (~~12-1, 12-2~~) further comprise[[s]] a hole (~~18-1~~) of a predetermined magnitude in the area surrounded by the fourth and fifth slits, the first pressing part (~~14-1~~) and the intermediate rod (~~15-1~~).

7. (Currently amended) The stage according to claim 6, wherein the first and second X-line motion parts (~~13-1, 13-2~~) comprise[[s]] first and second X double springs (~~13-1B, 13-2B~~) connected to the third and fourth X ends (~~16-3, 16-4~~) through the first and second slits (~~19-1B, 19-1C~~), and third and fourth X double springs (~~13-1A, 13-2A~~) connected to the first and second X double springs (~~13-1B, 13-2B~~) through a pair of slits (~~19-1D, 19-1E~~) having a predetermined length and formed in the parallel direction about the X [[]]axis, the ends of the third and fourth X double springs (~~13-1A, 13-2A~~) being connected to each other through the third slit (~~19-1A~~).

8. (Currently amended) The stage according to claim 7, wherein the respective first to fourth X double springs (~~13-1B, 13-2B, 13-1A, 13-2A~~) comprise[[s]] two intermediate rods arranged doubly, the respective intermediate rods comprising comprise a post part (~~13-1C~~) having a predetermined width, and a narrowing part having a thickness relatively narrower than the width of the post part by a semicircular groove having a predetermined radius in both ends of the post part (~~15-1A~~).

9. (Currently amended) The stage according to claim 3, wherein the first and second X-line motion parts (~~13-1, 13-2~~) comprise[[s]] first and second X double springs (~~13-1B, 13-2B~~) connected to the third and fourth X ends (~~16-3, 16-4~~) through the first and second slits (~~19-1B, 19-1C~~), and third and fourth X double springs (~~13-1A, 13-2A~~) connected to the first and second X double springs (~~13-1B, 13-2B~~) through a pair of slits (~~19-1D, 19-1E~~) having a predetermined length and formed in the parallel direction about the X [[]]axis, the ends of the third and fourth X double springs (~~13-1A, 13-2A~~) being connected to each other through the third slit (~~19-1A~~).

U.S. Patent Appln. No. 10/726,759

Docket No. 9665-1

Amendment

Reply to Office Action dated March 22, 2005

10. (Currently amended) The stage according to claim 9, wherein the respective first to fourth X double springs (13-1B, 13-2B, 13-1A, 13-2A) comprise[[s]] two intermediate rods arranged doubly, the respective intermediate rods comprising comprise a post part (13-1C) having a predetermined width, and a narrowing part having a thickness relatively narrower than the width of the post part by a semicircular groove having a predetermined radius in both ends of the post part (15-1A).

11. (Currently amended) The stage according to claim 2, wherein the Y-axis stage (20) comprises a piezoelectric element having a predetermined length, the length being changed in the direction of the X-axis according to an input voltage, and a first Y driving part (21-1) and a second Y driving part (21-2) connected to both ends of a longitudinal direction of the piezoelectric element (23), respectively, and fixed to the a first Y end (26) of the second X area (RY2) for moving the a second Y end (26) opponent opposite to the first Y end (25) in the Y-axis direction on the basis of the piezoelectric element (23).

12. (Currently amended) The stage according to claim 11, wherein the Z-axis stage (30) comprises a bottom part (34) having a predetermined area and thickness and fixing fixed within the second Y area (RY2) of the Y-axis stage (20), a Z-line driving part (31) moving in the direction of the Z-axis and formed integrally to the bottom plate (34) in the vertical direction, which is the direction of the Z-axis, from the surface of the bottom plate (34), and a piezoelectric element (33) mounted to have a decreased or increased length in the direction of the Z-axis in the a space (31-1) of a predetermined size, the space being a region to which the bottom part (34) and the Z-line driving part (31) are adjacent and formed in the Z-[[axis]]line driving part (31).

13. (Currently amended) The stage according to claim 2, wherein the Z-axis stage (30) comprises a bottom part (34) having a predetermined area and thickness and fixing fixed within the second Y area (RY2) of the Y-axis stage (20), a Z-line driving part (31) moving in the direction of the Z-axis and formed integrally to the bottom plate (34) in the vertical direction, which is the

{WP242445;1}

U.S. Patent Appln. No. 10/726,759

Docket No. 9665-1

Amendment

Reply to Office Action dated March 22, 2005

direction of the Z-axis, from the surface of the bottom plate (34), and a piezoelectric element (23) mounted to have a decreased or increased length in the direction of the Z-axis in the a space (31-1) of a predetermined size, the space being a region to which the bottom part (34) and the Z-line driving part (34) are adjacent and formed in the Z-[[axis]]line driving part (34).

14. (Currently amended) The stage according to claim [[1]] 2, wherein the Y-axis stage (20) comprises a piezoelectric element having a predetermined length, the length being changed in the direction of the X-axis according to an input voltage, and a first Y driving part (21-1) and a second Y driving part (21-2) connected to both ends of a longitudinal direction of the piezoelectric element (23), respectively, and fixed to the a first Y end (26) of the second X area (RX2) for moving the a second Y end (26) opposite opposite to the first Y end (25) in the Y-axis direction on the basis of the piezoelectric element (23).

15. (Currently amended) The stage according to claim 14, wherein the first and second Y driving parts (21-1, 21-2) comprise[[s]] first and second Y amplifying parts (21-1, 22-2) connected to both ends of a longitudinal direction of the piezoelectric element (23), respectively, for amplifying a displacement generated according to the driving of the piezoelectric element (23) and for moving the second Y end (26) in the direction of the Y-axis by the amplified displacement, and first ends of first and second Y-line motion parts (23-1, 23-2) connected to the first and second Y amplifying parts (22-1, 22-2), respectively, through the first and second slits (27-1, 27-2) traversing a part of the first Y end (26) and shifted in parallel in the direction of the Y-axis by the amplified displacement, the other second ends opposite opposite to the first ends of the first and second Y-line motion parts (23-1, 23-2) connected to the first and second amplifying parts (22-1, 22-2) being connected to each other by the a third slit (27-3).

16. (Currently amended) The stage according to claim 15, wherein the respective first and second Y amplifying parts (22-1, 22-2) comprise[[s]] first and second pressing parts (24-1, 24-2) receiving the displacement of the piezoelectric element 23, and an intermediate rod formed {WP242445;1}

U.S. Patent Appln. No. 10/726,759

Docket No. 9665-1

Amendment

Reply to Office Action dated March 22, 2005

in both sides of the first and second pressing parts (14-1, 14-2) symmetrically to the X-axis in the center of the respective first and second pressing parts (14-1, 14-2), the intermediate rod (24) comprising a post part having a predetermined width, and a narrowing part having a thickness relatively narrower than the width of the post part formed by a semicircular groove having a predetermined radius in both ends of the post part.

17. (Currently amended) The stage according to claim 16, wherein the first and second [[X]]Y-line motion parts (23-1, 23-2) comprise first and second Y double springs connected to the first and second Y ends through the first and second slits (27-1, 27-2), and third and fourth Y double springs connected to the first and second Y double springs through a pair of slits having a predetermined length and formed in the parallel direction about the Y-axis, the ends of the third and fourth Y double springs being connected to each other through the third slit (27-3).

18. (Currently amended) The stage according to claim [[1]] 2, wherein the Z-axis stage comprises a bottom part (34) having a predetermined area and thickness and fixing fixed within the second Y area (RY2) of the Y-axis stage (20), a Z-line driving part (31) moving in the direction of the Z-axis and formed integrally to the bottom plate (34) in the vertical direction, which is the direction of the Z-axis, from the surface of the bottom plate (34), and a piezoelectric element (33) mounted to have a decreased or increased length in the direction of the Z-axis in the a space (31-1) of a predetermined size, the space being a region to which the bottom part (34) and the Z-line driving part (31) are adjacent and formed in the Z-[[axis]]line driving part (31).

19. (Currently amended) The stage according to claim 18, wherein the Z-line driving part (31) comprises first and second Z-axis motion parts (31-1, 31-2) moving the a first Z end (36) positioned in the direction of the Z-axis from the bottom part (34) to the Z-axis on the basis of the piezoelectric element according to the driving of the piezoelectric element (33), wherein the respective first and second Z-axis motion parts (31-1, 31-2) include[[s]] the first and second Z double springs (31-1A, 31-1B) and the third and fourth Z double springs (31-2A, 31-2B) arranged

{WP242445;1}

U.S. Patent Appln. No. 10/726,759
Amendment
Reply to Office Action dated March 22, 2005

Docket No. 9665-1

in the direction of the Z-axis, the ends of the first and third Z double springs being connection connected through the a fourth slit (35).

20-21. (Cancelled)

22. (Currently amended) The device according to claim 21, A sample test device using a 3-axis straight line motion stage, the device comprising:

a 3-axis straight line motion stage supporting a predetermined sample and shifting the sample independently, precisely and exactly in the direction of the X-axis, the Y-axis or the Z-axis; and

an atom microscope provided with the 3-axis straight-line motion stage for measuring the location of the sample using a laser and for scanning the sample;

the 3-axis straight line motion stage comprising:

a bottom plate having predetermined area and thickness;

an X-axis stage, fixed in a reference area of the bottom plate, for moving in the direction of X-axis a first X area positioned from the reference area to the direction of the X-axis;

a Y-axis stage positioned within the first X area and fixed in a second X area, which is located within the first X area, for moving in the direction of the Y-axis a second Y area positioned from the second X area to the direction of the Y-axis; and

a Z-axis stage fixed in the second Y area, which is located within the first Y area and supports a predetermined sample for moving the sample in the direction of the Z-axis.

wherein the Y-axis stage comprises comprising:

a piezoelectric element having a predetermined length, the length being changed in the direction of the X-axis according to an input voltage, and a first Y driving part (21-1) and a second Y driving part (21-2) connected to both ends of a longitudinal direction of the piezoelectric element (23), respectively, and fixed to the a first Y end (26) of the second X area (R_{X2}) for moving the a second Y end (26) opponent opposite to the first Y end (25) in the Y-axis direction on the basis of the piezoelectric element (23).

U.S. Patent Appln. No. 10/726,759
Amendment
Reply to Office Action dated March 22, 2005

Docket No. 9665-1

wherein, the X-axis, the Y-axis and the Z-axis indicate axes of rectangular coordinates,
respectively.

23. (Currently amended) The device according to claim 22, wherein the Z-axis stage comprises;

a bottom part (34) having a predetermined area and thickness and ~~being fixed~~ within the second Y area (RY2) of the Y-axis stage (20),

a Z-line driving part (31) moving in the direction of the Z-axis and formed integrally to the bottom plate (34) in the vertical direction, which is the direction of the Z-axis, from the surface of the bottom plate (34), and

a piezoelectric element (33) mounted to have a decreased or increased length in the direction of the Z-axis in the a space (31-1) of a predetermined size, the space being a region to which the bottom part (34) and the Z-line driving part (31) are adjacent and formed in the Z-[axis]line driving part (31).

24. (Cancelled)